

FURTHER OBSERVATIONS ON MICRO-FILARIÆ, WITH DESCRIPTIONS OF NEW SPECIES.

By PATRICK MANSON, M.D., Amoy.

Communicated (with a Prefatory Note) by the PRESIDENT.

(Read June 25th, 1880.)

PLATES VIII, IX, X.

The interesting letters which I have now the honor to submit to the Club must be regarded as a continuation of Dr. Manson's former communication. Not merely does Manson refer to an abundant confirmation of his discovery respecting the periodical emigration and immigration of the human larval filariæ, but he here supplies us with a new fact, pointing apparently to the lymphatic system as the probable home or head-quarters, so to say, of the sexually mature worm (*Filaria Bancrofti*). For myself, this "find" has especial interest, inasmuch as it was the circumstance of my detection of the chorionic envelope of an ovum in blood sent from Australia and my communication of the fact to Dr. Bancroft that led to the original discovery of the sexually mature worm. This has been acknowledged by Bancroft. Curiously enough, in a letter received only a few days back, Dr. Sonsino (who has largely contributed to our knowledge of the filariæ, as they occur in Egypt), requested my opinion as to the precise residence or "ordinary abode" of the sexually mature *Filaria*. I think Manson's find tends to confirm the view that I have already entertained, if not decidedly expressed, that the home of the adult worm is to be found in the lymphatic channels. I own that the circumstance of my original "find" is somewhat puzzling, but the presence of the ovum in blood sent to me from Australia may have been accidental. Dr. Bancroft's detection of the adult worm in an enlarged gland or "lymphatic abscess" and Dr. Manson's present "find" point to the conclusion just advanced. Not only as regards size, but also as regards contour, do the empty ova detected by Manson and

myself absolutely correspond. The instant I saw Manson's figure of the "ovum," I recognised its identity with the empty egg-envelope found in the blood of the Australian.

In the first of the two letters forming the present communication, Dr. Manson describes new parasites from birds that are common in China. As he has given them no names, I have called one of these *Filaria picæ mediæ* (also found in *Gracupica*) and another *Filaria corvi torquati*. I may mention that I have already applied the term *Filaria Mansoni* to another worm which infests the eyes of domestic fowls in China ("Parasites," p. 441.)

The subject of avian nematode parasites is already becoming sufficiently complicated. Long ago Dr. Sonsino, now resident at Tintah, communicated to me some account of his discovery of Microfilariae in the Egyptian crow, and the subject has since been much extended by Lewis in regard to the Indian crow, which, if I recollect rightly, is the same bird by another name (*Corvus splendens*). In fact nematoid hæmatozoa have been found in a great variety of birds, and not unnaturally those found in crows have been conjectured to hold some genetic relation with the very common *Filaria attenuata* which infests, indiscriminately, crows, rooks, nutcrackers, magpies, and even also the ground woodpeckers (*Colaptinæ*). Evidently we are only on the threshold of this enquiry, and the elucidation of the subject is beset with practically endless difficulties. In reference to the specimens sent by Dr. Manson, I regret to say that the bottle containing adult filariæ from *Corvus torquatus* arrived broken up into a hundred fragments, but the bottle on the table, as the label states, shows a number of "Chinese magpies' hearts, with parent filariæ in the semilunar valves, both aortic and pulmonary." The pen-and-ink illustrations sent by Dr. Manson were accompanied by brief indications of their separate nature. These I have carefully collected and arranged in such a manner as to form special plates. I have also ventured to amplify the descriptions in order to explain the plates made up from the sketches. The latter, though little more than outlines, have evidently been executed with great care, and thus they will become especially valuable to systematists and others desirous of studying the genesis of avian filariæ.

In connection with Dr. Manson's previous paper, I may mention that, as supplementing the ordinary and large circulation of our Transactions, separate copies have been transmitted to *savans* resident in

foreign countries, and although acknowledgments on the part of investigators are now generally held to be unnecessary, several foreign gentlemen interested in Manson's researches have expressed their sense of gratification at the progress helminthology is making at the hands of our countryman in China.

T. S. COBBOLD.

"Amoy, 19th April, 1880.

"T. Spencer Cobbold, Esq., F.R.S.

"DEAR SIR,—I read in the *Lancet* of 6th March, with much interest, the short account of the meeting of the Quekett Club, on the previous week, and the discussion on *Filaria*. My only regret is that I did not supply you with fuller details of my observations and more decided proof of my assertion about the periodicity of the filaria's appearance in the blood. I am very grateful to you for the trouble you have taken in bringing these forward, and cannot but feel that, unless for your kind assistance, my work would lie entombed in the 'Customs Gazette,' and be of little use to any one. The paper I hope to send herewith, though prepared seven or eight months ago, is only just printed. It contains a short account of my observations on periodicity, and abundant proof of my position. I believe it will have some interest for you, especially that part which describes the formation of the sheath of the embryo hæmatozoon of *Corvus torquatus*, and the discovery in the lymphatics of the ova of *Filaria Bancrofti*.

"Believing they are new to you, I send, under the care of Dr. Faulkner, surgeon of the SS. 'Agamemnon,' specimens of the parents of the hæmatozoa of *Corvus torquatus*, and also a number of hearts of the Chinese magpie, *Pica media*, containing very ingeniously located parent worms of a species of filaria common to that bird and to *Gracupica nigricollis*. I also enclose in this letter some rough sketches illustrating the embryos, etc., and will, in the sequel, give you a brief account of what I have made out about these interesting parasites.

"*Hæmatozoa of Pica media*.—I have examined many, I suppose thirty or forty, magpies, and have never failed to find hæmatozoa in any of them. But though I searched diligently in all the viscera and large vessels, I was a long time in discovering the habitat of the parent. At last I came across a female larva in a small clot

in the right ventricle, which by rough manipulation I must have displaced. This find put me on the right track, but many birds were sacrificed in the hunt before I could find a second specimen, and definitely pronounce on the exact spot they occupy. At last I observed a minute white tubercle, the size of a No. 6 shot, apparently lying in the pocket of a semilunar valve, and, on trying to turn this out, had the satisfaction of finding it was the much sought-for worm lying coiled up with its mate, either free in the pouch of the valve, or just under the endocardium. By splitting up the pulmonary artery and aorta from the ventricles, one or more of these pale yellowish tubercles can be found in every magpie. I have seen the valves nearly all occupied by them, some of considerable size, so that the circulation must be interfered with to quite a serious extent. The worms are found sometimes in the pulmonary valves, sometimes in the aortic, and often in both. A perfect tubercle contains a pair, male and female. I think they are encysted, or at least under the lining membrane of the valve, but their presence causes so little irritation that the delicate membrane covering them is quite transparent, allowing good eyes to see distinctly through it the coils of the worms. To see these one must look into the opened pouch. I believe the young are emitted into the circulation through a minute aperture in the covering. In case the specimens I send do not turn out well, I give you a short description of the parents :—

“Male.—Length, $\frac{3}{4}$ ”

Diameter at neck, $\frac{1}{400}$ ”.

Greatest diameter, $\frac{1}{35}$ ”.

Diameter of alimentary canal, $\frac{1}{400}$ ”.

Ditto testicle, $\frac{1}{300}$ ”.

“Tail strongly incurvated. Double spicule. One or two very minute caudal papillæ. Blunted and slightly bilobed tail tapering down from body. Mouth simple. Œsophagus straight, $\frac{1}{6}$ ” in length, terminating in alimentary canal by gradual dilatation. Alimentary canal parallel to testicle, straight, and filled with dark granular material. Integument in both sexes covered with minute characteristic tubercles or bosses ; these are largest about the middle of the animal, and less marked towards head and tail.

"Female.—Length varies very considerably—about $1\frac{1}{2}$ " is the average.

Greatest diameter, unimpregnated, $\frac{1}{125}$ ".

Ditto ditto, impregnated, $\frac{1}{80}$ ".

Anus, $\frac{1}{208}$ " from caudal extremity.

Vagina, infundibuliform, opens $\frac{1}{100}$ " from mouth.

Mouth œsophagus and alimentary canal as in male.

Uterine tubes unite anteriorly to form vagina which runs forward in a straight course.

Expressed embryos measure $\frac{1}{200}$ " by $\frac{1}{5500}$ "; they are naked and have truncate tails.

"Free embryos. If one examines the blood of the magpie, there is usually no difficulty in finding plenty of embryos, and at first sight seemingly of two different kinds, one minute species, $\frac{1}{250}$ " by $\frac{1}{5000}$ " or thereabouts, the other larger, $\frac{1}{110}$ " by $\frac{1}{5000}$ ". The smaller are languid, the larger active in their movements. A jerking, pouting, oral movement is characteristic of both. In both the mouth seems quite simple and the tail sharp and pointed. In neither have I seen any trace of lash or double outline. Betwixt the extremes of length I have given, intermediate sizes can usually be found. Neither extreme corresponds exactly with the dimensions of the embryos in the vagina of the presumed parent. There is also considerable variation in the breadth of the smaller specimens. Query—Do the embryos found in the blood belong to the same species, and are they thus early commencing development and separation into male and female? Last December I examined a female parent from the heart-valves, and found in her vagina embryos of $\frac{1}{200}$ " by $\frac{1}{5000}$ ", and having truncate tails. In the same bird were two male worms, and another unimpregnated female. I found no large free embryos in the bird's blood, only numerous small ova very short and very stout, $\frac{1}{225}$ " by $\frac{1}{3000}$ "; therefore, if the valve worms were the parents of the embryos free in the blood, their offspring must have diminished in length, increased in breadth, and have had their tails sharpened. And if the larger specimens of free embryos are also the progeny of the valve worms, they too must have had their tails sharpened and grown in length at the same time.

"You will require to use great gentleness in removing the worms from their cysts, as they are very delicate and easily broken. I have half extracted the worm in some instances as a guide to the

situation the rest of the body occupies. The ventricles and vessels have been split up, and unless the spirit has altered appearances very much, you will have no difficulty in finding the parasites. Perhaps before attempting their removal it would be well to soak the heart in some solution of about the specific gravity of blood. I find urine answer very well for this purpose; it restores the proportions lost by exosmosis.

"*Hæmatozoa of Corvus torquatus*.—About one third of the crows I have examined contained two kinds of blood worms. These two kinds are quite unlike each other, but whether they are of distinct species or only different stages of the same I am not prepared to say. Of the two kinds the larger measures from $\frac{1}{100}$ " to $\frac{1}{120}$ " by $\frac{1}{3000}$ ", the smaller $\frac{1}{165}$ " by $\frac{1}{5500}$ ". The former is very active and has a lashing, free, vigorous style of movement; the latter is languid and has a slow, wriggling, worm-like motion. The oral movements in both kinds are very distinct, and when it is open four papillæ can be distinctly seen surrounding the mouth. In the larger species a bright line extends backwards from the mouth into the body suggesting an œsophagus. The tail of the larger kind is gradually tapered down and pointed, and the general contour of the body and habits of this embryo resemble very closely those of the embryo of *Filaria immitis*. The tail of the smaller kind tapers but slightly and is abruptly truncated, and by careful focussing one can in most specimens detect a thin skin extending like a loose bag or hood from the head. The truncated tailed and hooded embryos die very soon after being placed on the slide, but their companions I have seen alive and active in an oiled slide ninety-six hours after their removal from the host. Though the proportion of these two kinds of embryos varies considerably in different birds, yet where one is found the other is sure to be present also.

"Parents are sometimes found in the right ventricle, but most commonly in the pulmonary artery and its branches. The best way to find them is to open the pericardium, and after dragging the heart well up with a hook transfixing its apex, scrape with a blunt knife as much as possible of the soft lung tissue from the pulmonary arteries and then divide them deep in the lung. They can then be easily split up or divided at intervals and the worms expressed. Those I send you were thus obtained, and are the produce of one bird.

“ Male—Length $\frac{3}{8}$ ”

Greatest diameter $\frac{1}{150}$ ”

Diameter of neck $\frac{1}{400}$ ”

Length of œsophagus $\frac{1}{40}$ ”

Diameter of alimentary canal $\frac{1}{600}$ ”

“ The body in both sexes is smooth and very transparent. Mouth simple. Œsophagus very wide near its termination in the intestine. Spicules double. No papillæ. Tail tapering to blunt extremity. Testicle extends to near œsophagus where it is doubled on itself. Arms close to end of tail.

“ Female—Length $\frac{3}{4}$ ” to 1”

Diameter $\frac{1}{90}$ ”

“ General appearance the same as the male. The vagina spans about $\frac{1}{100}$ ” from the mouth. If the female is placed in a suitable medium such as aqueous humour, she retains her vitality for some time, and the movements of parturition can be distinctly seen. At short intervals a peristaltic contraction commencing in the uterine horns and increasing in force as it descends to the vagina expels every few seconds a small group of embryos of the blunt-tailed hooded description. A section of the worm some distance from the vagina permits the escape of embryos, plainly showing the gradations of stretching that converts the chorionic membrane into the sheath of the free embryo (see illustration). Do you consider the sharp tailed, vigorous and larger hæmatozoa of the same species and advanced in development as specifically distinct ?

“ *Hæmatozoa of Gracupica nigricollis*.—This bird harbours two, if not three, distinct species of hæmatozoa. One, such as I have described in the paper, I send you, measuring about $\frac{1}{95}$ ” by $\frac{1}{3500}$ ”, with a tail not quite sharp, very vigorous and destitute of lash or hood. Another measuring in length $\frac{1}{160}$ ”, and a third kind (associated with the valve worm), $\frac{1}{200}$ ” by $\frac{1}{7500}$ ”, probably the same as those of *Pica media*—though offspring and parents were more minute in the birds I have examined. The valve worm is exactly like that of *Pica media*, having the characteristic bosses studding its integument.

“ *Hæmatozoa of Goura coronata*.—This bird comes from the Malay Archipelago. It lived in confinement in China for almost a year, but last winter died—apparently from cold. Its blood contained a fair proportion of hæmatozoa with head and tail lashes exactly like those of *F. sanguinis hominis*. I examined the heart, large

vessels and viscera, but found no parent form. The embryos measured about $\frac{1}{50}$ " by $\frac{1}{5000}$ ". Its tail was unlike that of *F. s. h.* being truncated and slightly bulbous like the point of a "Bougie Olivaire." I observed that there seemed to be a sort of articulation (and something of the same sort I have seen in *F. s. h.*), about $\frac{1}{2000}$ " from the tip of the tail, for when in motion this part was often bent at an angle and not in harmony with the sweep of the rest of the body. The integumental character of the lash was very evident, and double outline could be recognised in the body. Often the bag or lash could be seen most distinctly long distances from the tail. There was no trace of vessel in the body, which appeared to be quite homogenous even under a high power.

"I trust these notes, along with the specimens and paper I hope to send you, may be of some interest, and I would again request you to make what use of them you see fit.

"Apologising for the trouble I give you, and again thanking you,

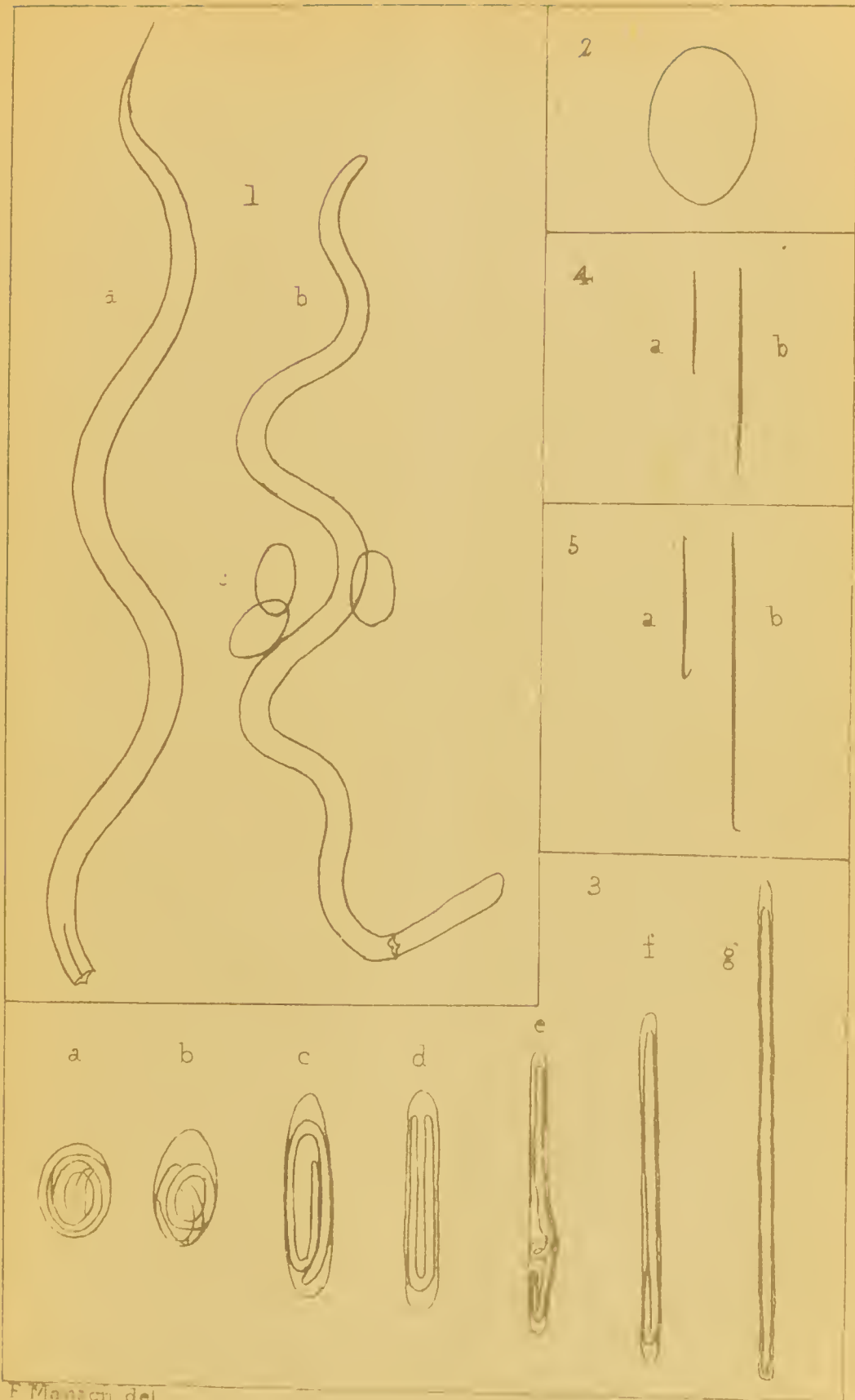
"Believe me,

"Yours faithfully,

"PATRICK MANSON."

DESCRIPTION OF PLATES VIII, IX.

- 1.—Outline representation of large Hæmatozoa (*a, b*) and three blood corpuscles (*c*) of *Corvus torquatus*. $\times 350$ diameters.
- 2.—Outline of an ovum of *Filaria Bancrofti* found in the inguinal lymphatics. $\times 350$ diam.
- 3.—Seven illustrations (*a-g*) showing the mode of formation of the sheath of the smaller hæmatozoa infesting *Corvus torquatus*. $\times 350$ diam.
- 4.—Mature examples of the male (*a*) and (*b*) female *Filaria corvi torquati* (Mans. and Cobb.) Natural size.
- 5.—Mature examples of the male (*a*) and (*b*) female *Filaria pica media* (Mans. and Cobb.) Natural size.
- 6.—Head (*a*), tail (*b*), and section of the body (*c*) of a male *Filaria corvi torquati* (Mans. and Cobb.) $\times 350$ diam.
- 7.—Head (*a*), tail (*b*), and section of the body (*c*) of the male *Filaria pica media* (Mans. and Cobb.); the head of the female worm (*d*) being also represented to show the narrow œsophagus and also the outlet of the vagina immediately below the mouth. $\times 350$ diam.
- 8.—Outline representations of nematoid hæmatozoa from *Pica media* (*a*), from *Gracupica nigricollis* (*b*), from *Corvus torquatus* (*c*), from *Goura coronata* (*d*) and from the dog (*e*), showing their relative sizes and forms. $\times 350$ diam.



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"Amoy, 4th May, 1880.

"T. Spencer Cobbold, Esq., F.R.S.

"DEAR SIR,—I hope you will excuse me troubling you with another letter so soon ; but it is only because I think you are interested in the subject of worms even more than I am, that I venture to tax your patience so frequently.

"First, I am sorry to say that the paper I intend sending you has not arrived yet.* I regret this the more as it would partly explain what I write about now. Briefly—from observations in the day I have some reason to think that the embryos of *F. Bancrofti*, while absent from the general circulation during the day, are resting in pulmonary circulation. To test this idea, I have for a long time been on the look-out for cases of hæmoptysis, that I might obtain lung blood at the proper time. Hitherto I have never met with a blood-spitting filarious patient. But some time ago a Chinaman consulted me about some eczematous patches on his face and legs. While he was speaking to me I observed that his voice was very rough, and that once or twice he hawked up sputum tinged apparently with blood. I thought he had a chance of being filarious, and so put a little of the sputum under the microscope. But instead of finding it swarming with filariæ, I found it plentifully besprinkled with the ova of some other parasite.

"Enquiring about his history, I learned that he was a secretary in the salt mandarin's office in comfortable circumstances ; that he was a native of Foochow, where he had resided till he was 21 years of age. He is now 35. Eight of the intervening years he spent in North Formosa, at a town called Tiek Tcham, and it was in this place, a year after his arrival there, or about 13 years ago, that hæmoptysis first began. The history of the hæmoptysis he describes as follows—When 22 years of age it began. Every day he spat from an ounce to half an ounce of blood for 19 days in succession. He had very little cough. At first the expectoration was pure blood, but after three or four days it became mixed with mucus. Hæmoptysis returned six months afterwards ; the blood was smaller in quantity, and appeared in the sputum for three or four days only. Since then he has spat blood for a few days at a time every two or

* Since Dr. Manson's paper was read, I have received the printed communication referred to. It came to hand July 28, 1880, and is entitled "Additional Notes on *Filaria sanguinis hominis* and Filaria-Disease." The paper is illustrated by four photographic plates of Elephantiasis Arabum.—T. S. C.

three months, without cough, the blood being mixed with mucus after the first mouthful of pure blood. He is in good general health. His eczema he attributes to a severe attack of scabies. His father is dead, but never had cough; his mother died ten years ago of cough. Two brothers and two sisters alive and well. Though he is thin, there was no auscultatory sign of phthisis, and I could not but associate the parent of the ova and the hæmoptysis as cause and effect. He has no filariæ in his blood.

“From November 5th to December 18th, 1878, I had in hospital here a Portuguese, for many years a resident in North Formosa. He came over from Formosa sick. I diagnosed thoracic tumour, probably aneurism. He improved with the rest and returned again to Formosa. In June, 1879, he died suddenly, and Dr. Ringer made a post-mortem examination, with the particulars of which he kindly furnished me. Death was caused by rupture of an ascending aortic aneurism into the pericardium. He found the lungs slightly congested, and on making a section, came across a small parasite lying on the lung tissue, which he says might have escaped from a bronchus.

“When my Chinese patient told me he had been long resident in North Formosa, and that his hæmoptysis began there, I thought it not at all unlikely that Dr. Ringer’s parasite and that in the lungs of my patient were identical. Dr. Ringer kindly, in reply to my letter, sent me the parasite—the only specimen he obtained—and in the sediment of the spirit I found ova of the exact dimensions and general appearance of those I found in the sputum of the Chinaman.

“I could not find in your ‘Parasites’ a worm to correspond, and as I have some idea that this worm is not an unfrequent cause of hæmoptysis in Chinese, I turn to you for more information. I send the worm—evidently a fluke—and also a sample of the Chinaman’s sputum. I also enclose drawings of eggs and outline of the parasite in case my package miscarries. I fear the worm is somewhat mutilated, but, I trust, not past recognition.

“Yours faithfully,

“PATRICK MANSON.”

NOTE BY THE PRESIDENT.

“On returning home from the Q. M. C. Meeting, I found that Dr. Manson’s ‘package’ had arrived. The sputum I have not

2



a.



b.



c.

1



3



a.



b.



e.



d.



examined at present ; but on the 27th of June I satisfied myself that the fluke was new to science, and accordingly I propose to call it *Distoma Ringeri*, after the discoverer. Though mutilated, the oral sucker was well shown, as also were traces of an organ which I regarded as the remains of the ventral acetabulum. When flattened on a glass-slide, the capsules of the vitellarium were well seen, and occupied fully four-fifths of the body, lying deep under the dermal surface. The worm reminds me very much of the fluke *Distoma compactum* which, many years ago, I detected in the lungs of an Indian Ichneumon, but it is much larger and evidently a distinct species.

“ T. S. COBBOLD.”

DESCRIPTION OF PLATE X.

- Fig. 1.—Outline of a fluke obtained from the lung of a Portuguese. (*Distoma Ringeri*, Cobb.) Nat. size.
- Fig. 2.—Eggs of a fluke from the lung of a Portuguese. $\times 350$ diameters.
a, *b* with the operculum detached ; *c* with the contained embryo.
- Fig. 3.—Five separate views of ova taken from the sputum of a Chinese ;
a, *b* and *c* with their opercula detached ; *d* and *e* with the shells ruptured by the covering glass. $\times 350$ diameters.

